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ABSTRACT

A study examined the effect of computer assisted instruction on the reading achievement of third- through sixth-grade students in a low socio-economic status community. Subjects were 23 students randomly selected from 41 students who received computer-assisted instruction and 23 students randomly selected from 28 students who did not receive computer assisted instruction. Subjects attended a Chicago, Illinois public school located in the Lawndale community of the city's west side. Students who scored at or below stanine three on the Iowa Tests of Basic Skills were randomly assigned to traditional basal reading instruction, or to reading instruction using the computer. Results indicated that reading scores were not affected by computer usage. Results also indicated no significant differences between boys' reading achievement based on method of reading instruction, or between girls' achievement based on method of instruction. (Contains 1 table of data and 23 references.) (RS)

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COMPUTERS AND READING ACHIEVEMENT

Vanessa Hamilton

Although computers have been utilized in the Chicago Public Schools for a number of years, students have traditionally been exposed to them only through federally finded programs such as Title I, which targets low-achieveing or at-risk students. Microcomputers could provide endless practice opportunities within a nonthreatening context, and more important, they were an alternative to traditional approaches that often failed when used by students experiencing learning difficulties (Kolich,1991). Achievement was expected to rise because of the computer's capacity to submerge the student in information using a variety of modalities.

Recently there has been a major thrust to integrate science, math and technology. Coupled with this thrust is the national trend to make all citizens "computer literate", the rationale being that ours is an information age. Those unable to access and process data in a meaningful way will find themselves unemployable. Entire curricula are being developed, finded and mandated by the government to reach this goal. For many schools this translates into exposing all children to the finctions of calculators and computers. In order to fulfill this new role, classrooms, not isolated labs must be employed .

However, computers are not inexpensive tools. The initial costs to provide hardware, software, teacher training, not to mention on-going electrical bills is not small. In addition, rewiring most of the city's schools to meet power demands and the necessity of lengthy service contracts to repair systems suffering from a 'virus' can and will drain huge amounts of the school's resources.

More important is the question of whether or not computers present a viable, predictable method of instruction, that is, are they effective and cost efficient as an educational tool? Many educators work from the premise that you teach a child based on what the child already knows and expand that knowledge. Certainly the majority of American children watch television. It is a familiar, comfortable medium and so common that more homes have televisions than books. Children easily make the transition from television watching to using a computer. It is hoped that computer use will inspire children turned off by traditional paper and pencil methods acheive at levels beyond those currently demonstrated. Current fiscal concerns are neglible if it can be demonstrated that children exposed to computer assisted instruction are happier, more productive members of our society, ie, students gain more academically and are enabled to compete globally through computer use. With technology and software changing so rapidly researchers must continually explore its different aspects on acheivement. The question of computer worthiness as it corresponds to reading achievement will be addressed here.

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Historically, computer assisted instruction has consisted of drill and practice, that is, a concept was taught in the regular classroom setting and then children or adults were sent to the computer where they were assigned a series of problems similiar to the ones taught in class. The computer assignments reinforced previously taught skills. When a degree of mastery was met, the student moved on to more difficult problems. Drill and Practice programs were orginally developed by Patrick Suppes and Richard Atkinson from Stanford University in 1968. As late as 1984 seventy-five percent of all educational programs were in this category (Simonson and Thompson, 1994).

The second stage of educational computer development came upon the heels of a drill and practice backlash. Opponents claimed drill and practice programs did not make full use of the computer's capacities. Often cited as being a very expensive "electronic workbook" computers collected dust in the few schools who had them. This opened the door for tutorials. Tutorials were developed in the mid 1980's and were designed to tutor or teach students new skills. With the introduction of artful intelligence systems, students were allowed to interact with the computer. One advantage being that students were no longer considered passive receipents of knowledge. The computers could adjust the pace and presentation of materials based on how the student responded. As with earlier programs, the computer kept track of achievement and provided instant feedback.

Currently we are in the stage of simulations and hypermedia. Simulations are the re-creations of naturally occurring phenomena. Students are allowed to change different variables and see what happens. This is discovery learning in which children get the opportunity to experiment with quasi-real life situations. Unlike previous programs where the responses are predetermined, students, can apply the higher thinking skills as indicated in Bloom's Taxonomy (Oliva, 1988). They are permitted to analyze, syntheze and evaluate what they see. Hypermedia carries this process a step further, students can gather information from a variety of sources via cable, CD-ROM, stereo and international databases and integrate them into a total, polished presentation.

As with all pedalogical practices, computer assisted instruction has as its core several educational theories. They are behaviorism, systems and cognitive theories. Behavorialism is based on the postulate that instruction should result in observable and quantifiable behaviors in the learner. Noted behavioralist B.F. Skinner proposes that learning occurs as a result of stimuli or cause and its reinforcement, the effect. The resultant learning is dependent on the types and quantity of reinforcement received. Motivation is a result of environmental conditions and the response variables associated with it (Hall and Lindzey, 1970). In keeping with this philosophy today, teachers across the country are required to write behavioral objectives along with the sequencing of skills in their short and long range lesson plans. This is aligned with the current legislative push for accountability throughout the teaching community. The country expects certain skills to be taught at certain times and within certain guidelines.

In a final analysis, computers as a teaching tool, could demonstrate in quantitive terms what a student could or could not do with more ease than a teacher because of the logic structured into its programs and the speed at which this task could be performed. Although early programs did not break down student's responses so that the type of error could be determined, the more sophisticated software of today can do so. A teacher can monitor the type of error the student makes and encode corrective measures into the program. Systems theorists further defined how this can be acheived. Based on the belief of natural order and rationally in problem solving, software developers follow a systematic, scientific approach. Simonson and Thompson (1994) supported the steps that follow:

System Definition
- a. Identify problem
- b Analyze setting
- c. Organize management

System Development
- a. Identify objectives
- b. Specify methods
- c. Construct prototype

System Evaluation
- a. Test prototypes
- b. Analyze results
- c. Implement/recycle

The final set of theories directly linked to Computer Assisted Instruction is probably the most important to educators, that of the Cognitive Theorists. Cognitive theorists view learning as a series of processes which the child acquires as he grows. They view learning as based on several important concepts. The first of which is the child's predisposition to learn followed by the organization and structure of the material to be learned and the sequencing of learning experiences. Piaget suggests that children of different ages possess qualitatively different ways of thinking or solving the same problem. These ways of thinking have a consistent series of steps in sequence and each of the stages is a hierarchical reintergration of the steps that have gone before (Wrightsman, 1972).

Furthermore, Bloom's cognitive theory requires complex concepts be broken down into smaller parts which build upon each other until ideas or concepts can be generalized into other areas (Oliva, 1988). Program designers have used these stages to produce interactive and hypermedia software geared toward providing students with simulations where they obtain hands on experieces (discovery learning) control the sequence of learning experiences (readiness to learn) and learn using their own particular modality. Papert's LOGO was one of the first programs written and used widely among educatiors supporting discovery learning.

Before one can adequately explore the use of computers in the classroom, one should be familiar with technology's special lexicon. The following terms are used to describe what takes place when a student accesses a computer. Be aware that many authors use them interchangably.

CAI - Computer Assisted Instruction - programs used to teach students new information, reinforce concepts or change their attitudes in a predetermined way.
CBL - Computer Based Learning - new term for programs used to teach students new information, reinforce concepts or change their attitudes in a predetermined way.
ILS - Integrated Learning Systems - includes comprehensive multimedia hard and software programs designed to branch (access learner's level, teach chunks of subject matter, reinforce concepts and post-test)
CMI - Computer Managed Instruction - Programs designed for teacher use, such as recording and calculating grades, recording student attendance and progress.
Discovery Learning - gaining concepts through real-life or hands-on experiences.
LOGO - High level program which uses turtle graphics and language to create programs.
Interactive multimedia - programs that require feedback from the user to access information sources.
Hypermedia - programs that allow the user to intergrate sound, animation, graphics and text through a variety of paths into one document. It requires interaction of the user and large computer storage capacities. Hypermedia was designed to allow the student control of his own learning by using a variety of stimuli and his own interests as guides.

Whatever the terminology used, there are several major obstacles in the path of computer utilization in schools. The foremost stated is the lack of relevancy. According to Peck and Dorricott (1994) educators feel that computer usage offers them somewhat less than the business world because of education's focus of man's humanistic nature. They also cite the tendency of computer usage to increase the teacher's workload as teachers must first acquaint themselves with the technology, jargon and software capacities. They must then spend time to integrate all of the above into the regular curriculum. The research of Hancock and Betts (1994) remarks that "A key obstacle to the use of technology in schools is the limited support teachers have for integrating unfamiliar technologies into instruction. As a result, teachers frequently avoid new technologies or use them for purposes other than those for which they were designed."

Pelgrum (1992) coorborates these findings, stating the dearth of staff development as a major contributor to lack of computer use. In areas where the numbers of computers are limited, instructors must also provide a schedule of who uses the computer, where, when and in what capacity. Many educators will admit they don't use the computers they have because of time constraints and freely voice the opinion that resources would be better utilized in other ways.

Furthermore, Ramey (1990) in her report on compensatory education found no significant difference in primary reading scores between the CAI and control groups, the intermediate level CAI participants had a negative trend. Lore (1989) reported gains in grades two and three. and lower scores in grades four through eight. Yet in direct contradiction, Williams (1993) found significant positive differences in reading scores. Darter and Phelps (1990) in their review of the literature found the results mixed..

Although researchers found mixed evidence of acheivment linked to computers, many school districts have caved into societal criticism and added computers as a response to parental pressure rather than demonstrated need. The problem was further complicated by software non-aligned or skills taught in isolation. Means and Olson (1994) were not surprised that early programs did not work because they "were an imperfect and incomplete match with the bulk of the core curriculum." In defense of the earlier programs, they did provide instant feedback and time-saving advantages of record keeping.

That computer assisted instruction worked in some settings was viewed as being due to the novelty of computer use. Students found the CAI atmosphere enjoyable, Askar, Yavuz and Koksal (1992) states pupil responses to computer assisted instruction environment scale assessing perceptions about the difference between computer assisted instruction and regular classroom settings are all in favour of CAI. Additionally, the novelty of computers in the classroom appears to inspire children to explore its use. Many teachers report learning more about the computer from their students than from personal, exhaustive research and experimentation with the furnished reference guides.

However a problem still remains with computer anxiety among teachers and gender differences among students. The first problem of teacher anxiety, suggests Hancock and Betts (1994), can be addressed in staff development and college prepartory programs. The United Kingdom has issued four Orders (new laws) making it mandatory for institutions with teacher training programs to include information technology in their curriculums. "The basic handling of discs is a skill which provides a sound basis for using computers within any environment. Success in this skill was a morale and confidence enhancer for the students in our study once the mystique of the process was removed. This led to them feeling in control of the computer rather than vice versa (Simmons and Wild, 1991).

The second obstacle, of gender differences, according to Collis and Ollila (1990) exists among students as a result of differences in child rearing where sex stereotyping may be established as early as two years of age. They state, "A child's perception of sex-role stereotypes not only shapes his or her gender-specific behaviors but also may become a cognitive characteristic of the child, powerfully influencing information processing so that both attitudes and comprehension are affected." Furthermore, reading is considered a feminine activity which may explain why so many boys are less successful in school. Even so, computers are considered to be in the masculine domain. Their use in the schools may prove an added boon for the boys and a detriment to girls. According to this study, boys consistently expressed more interest in computer use. Using an adaptation of Downing's Activity-Object Opinion Survey, three groups of first graders were pre and post-tested in the areas of reading, writing and computer use. They found no significant difference in reading and writing scores yet a very significant difference in the amount of computer use. It remains to be seen whether the equalized reading and writing scores are a result of lack of gender differences or increased time at the terminal.

In Hooper's (1992) research the effects of ability grouping and CBI for math instruction was examined. As with other researchers, there was a significant correlation between CBI

and math acheivement. In addition he states that group instruction on the computer is more effective than individual computer use. One drawback he noted was that courseware designers often assume that students work alone and they rarely consider the needs of students working in groups.

Lockwood (1993) tested the effects of CAI in the corporate setting. She found no significant difference on pretest scores of the CAI and classroom employees. However, employees in the CAI group had significantly higher posttest and gain scores. Furthermore, CAI reduced the learning time.

Eventhough many of the hurdles of computer education in the above sections are still being dealt with, there remains some very positive outlooks for the use of computers in education. The first of which is that computer usage is not a fad. Entire business communities would cease to exist without this technology. The recent push to integrate technology into all facets of civilized, organized society is a fiscal and global reality. The information highway is not a facet we can ignore.

Proponents of computer assisted instruction have valid reasons for adhering to their position. After the "dark ages" of drill and practice, there has been an expansion of knowledge, research and the applicability of computer usage in education. The following is an excerpt of what current researchers are saying about the newer computer technology.

1. The use of technology in some instances reduces the time necessary to master chunks of information.
2. It allows the individual to self-pace.
3. Teachers can assign more complex problems. Using databases and networks students locate more information for analysis and interpretion. They also can learn some word processing skills.
3. Large geographically diverse groups can be addressed at one time. This is called distance education. Students have access to modems, cable or satellie dishes and video cameras. In effect they can learn of cultures, languages and other subject areas through direct interaction with persons on the other end of the line. Harrison and Stephen (1992) emphasize that "Others have attributed a democratization effect to the impersonality of computer interaction as compared to face-to-face interaction. Interaction using computerized text minimizes the disparity of interpersonal and professional status, thus making it easier to disagree with others and argue in favor of unpopular opinions."
4. Where simulations are used, it permits individuals to interact with realistic models and complex processes that might be too costly, dangerous, impractical, or not possible at all without computer resources. Lockwood (1993) For example, Rieber (1990) in his study of animated graphics and science cites the following as distinct advantages of computer use. Students can not be passive observers. Nastasi, Battista and Clements (1990) further suggests that higher level cognitive processes are facilituted when the students worked in groups.
5. The role of the teacher shifts, is the opinion of Hancock and Betts (1994). The teacher becomes less the informer, lecturer or presenter and more the mentor or coach. This, they

say is due to students collaboration and small- group work. Schools move from teacher orientation to student centered.

With the proliferation of educational courseware, it is often difficult to determine what will meet the aims of the teacher and the goals of the student. Currently there are many studies on the software that children interact with. Intelligent computer aided learning systems are being developed using the student as model. Boyd and Mitchell (1992) lists six key components for a good tutorial. This model takes into consideration the identity of the student - not just his name, but his personality, goals, current knowledge and work pace. Kolich (1991) has also explored several facets of vocabulary building software finding a mixed approach most effective.

Although software is now being updated to help students reach the higher level thinking arena, they will also need to be examined and tested for effectiveness. It remains for future researchers to explore the effects of the new hardware and software on student acheivement.

Overall, the research has shown mixed results in the area of achievement. For the mildly challenged, the use of speech feedback has increased vocabulary development. For those students who fall within society's norms, computer use has been shown to be effective in reducing learning time, whether or not that can be translated into more sustained knowledge over a period of time is a question that needs to be addressed in future studies. Undeniably computer use has been effective with some students under certain conditions. Slower students achieve at a higher rate until they reach the intermediate or junior high year slump, when the majority of inner city children appear to make no progress. The more advanced, interactive programs which give control to the learner holds promise for a longer lasting impression on the student.

Statement of the Problem

What is the effect of computer assisted instruction on the reading achievement of third through sixth grade students?

Population:

The population for this study includes 69 students in grades three through six. The students attend a Chicago public school located in the Lawndale community on the city's west side. The student composition is 97.6 African-American and 2.4 percent Latin; 98.2 percent qualify for free lunch, placing them in the low socio-economic status group.
From the 69 students in grades three through five, student records show that 41 received computer assisted instruction while 28 did not. All 69 students had stanine scores of 3 or below. Twenty-three students were randomly selected from both the CAI group and non-CAI participants.

An assessment was made of school records identifying those children who had received computer assisted instruction and those who had not. The Iowa Test of Basic Skills Subtest for Reading Comprehension for 1993 and 1994 will be employed for the posttest only control group design. The t-test will be used. The .05 level of confidence will be used to determine if there is any statistically significant difference between the mean scores.

Results

Students were tested using the Iowa Test of Basic Skills in the spring of 1993. Using this as a basis, students who scored at or below stanine three were randomly assigned to two groups. The first group received reading instruction using the computer, the second group was taught using the traditional basal method. The *t*-Test for independent samples was used to determine whether computer use could indeed account for raising reading scores. The tables that follow will indicate that the difference in means is insignificant at the .05 confidence level.

t-value = 0.36
Degrees of Freedom = 44
t-table value = 2.021
0.36 < 2.021

The null hypothesis is accepted. For the purposes of this study, reading scores were not affected by computer usage.

This researcher found in an interview with the Computer Lab teacher, that those students who had not received CAI were in most cases children with a stanine of three, therefore their initial scores were slightly higher. Children with stanines one or two were judged most needy and selected for the computer class under government mandate that those with greatest need are serviced first. Children who had a stanine of three were included when two conditions were met. The first condition being that they were in heterogeneously grouped classrooms where the number of stanine one's and two's were lower. For example, Mrs. X in room 305 has a range of stanines from one to seven. The original class was intended to be homogeneously grouped, yet because of transfers-in, late arrival of student records and low enrollment, she has received a number of students who score below the norm for the class. Those in the range from one to three were sent to the computer lab for reading instruction. The second condition being that they were placed in homogeneous classrooms where all students qualify yet their teachers recommended them for the lab. Many of those students who achieved stanine three were considered borderline at-risk by their teachers. That is, they did not believe test results gave an accurate picture of what the child could do. Children scoring less than three were reported as using the "guess method" for completing the tests. Almost all finished the 40 minute test in record time - ten minutes. In a few instances, teachers assessed students as performing below their norm on the day of the tests. For the researcher the question arises as to whether the students who performed poorly are equivalent within the one to three stanine category.

After completing the posttest only control group design, the scores of the two groups were tabulated again to see if they were actually equal at the onset of the 1994 year. Using the T-Test for independent samples, the scores for 1993 were tabulated. The differences between the two groups was also insignificant.

By reason of small sample size at each grade level, the scores were not retabulated for maturity. However they were statistically checked by gender. There was no significant difference between the boys' CAI and non-CAI group or the girls' groups.

Boys (1993) t-value = 0.95 $df = 32$ t-table value = 2.042 0.75<2.024
Girls (1993) t-value = -0.34 $df = 20$ t-table value = 2.086 0.34<2.086

1993 Scores

t-TEST FOR INDEPENDENT SAMPLES

STATISTIC	VALUE
NO. OF SCORES IN GROUP ONE	23
SUM OF SCORES IN GROUP ONE	65.10
MEAN OF GROUP ONE	2.83
SUM OF SQUARED SCORES IN GROUP ONE	205.39
SS OF GROUP ONE	21.13
NO. OF SCORES IN GROUP TWO	23
SUM OF SCORES IN GROUP TWO	66.40
MEAN OF GROUP TWO	2.89
SUM OF SQUARED SCORES IN GROUP TWO	211.34
SS OF GROUP TWO	19.65
t-VALUE	-0.20
DEGREES OF FREEDOM (df)	44

The lack of significance between the two groups may be due to the small sample size. With the computers becoming more accessible to the larger student population it is possible that different groups of children will achieve at higher levels. It is also possible that the newer interactive software will promoted greater student learning. Researchers will need to test the results of using the greater technology on all types of students.

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